NAVAL HEALTH RESEARCH CENTER

PREDICTORS OF NAVY ATTRITION.

II. A DEMONSTRATION OF POTENTIAL

USEFULNESS FOR SCREENING

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Predictors of Navy Attrition. II. A Demonstration of Potential Usefulness for Screening

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The Sailors Health Inventory Program (SHIP) questionnaire is a medical and psychosocial history questionnaire completed by all Navy recruits. This study was an investigation of the potential usefulness of the SHIP questionnaire for screening to reduce basic training attrition. The sample consisted of 66,690 Navy recruits. Although the most valid individual SHIP items for predicting attrition tended to be psychological or behavioral in nature, a composite of 40 diverse SHIP questions (including medical questions) was found to be the best overall attrition predictor. Further analyses revealed that the 40-item composite is a considerably more powerful attrition predictor than is either educational credential or mental ability score, which together are currently the U.S. military's primary attrition management tools. Finally, the consequences of using different cutoff scores on the 40-item composite were simulated so that various hypothetical screening strategies could be considered.

Introduction

Of the background information gathered about military applicants, educational credential and Armed Forces Qualification Test (AFQT) scores have traditionally served as benchmarks for recruit quality and as tools to manage attrition.[1] The high attrition rates of recent years, however, suggest the need to determine additional predictors of success in the military. With that goal in mind, we determined the relationship between Navy 1-year attrition and medical and behavioral background factors assessed by a questionnaire from the Sailors Health Inventory Program (SHIP).[2] These results, which are presented in an accompanying article, indicate that many of the factors assessed by the SHIP questionnaire are significantly related to attrition. This article examines the practical usefulness of these results. Specifically, we address whether the findings are potentially valuable to the attrition reduction efforts of military personnel managers.

Hypothetically, personnel managers might seek to reduce attrition through new policies by which applicants are pre-screened and excluded from enlistment based on attrition-related SHIP items. There is little doubt that a successful effort of this type could lead to considerable cost savings. The General Accounting Office estimated that it costs the services between $9,400 and $13,500 in fixed and variable costs to recruit and train an active duty enlistee through basic training.[3] If so, then the Department of Defense invested more than $2 billion in

more than 176,000 enlistees in fiscal year 1994 alone. Therefore, it seems obvious that even modest reductions in basic training attrition might produce immediate savings of millions of dollars. But do questionnaires such as SHIP have the ability to identify a reasonable percentage of future attrites without also generating excessive numbers of "false positives" (i.e., successful accessions who are falsely predicted to attrite)? This is one of several issues that we sought to clarify.

Alternatively, personnel managers might wish to use survey items to direct at-risk individuals to remedial "counterattrition" programs during basic training. In recent years, the services have implemented a number of remedial programs that target first-term enlistees for retention.[4] At Recruit Training Center, Great Lakes, for example, the problem of recruit adaptation to the military has been addressed by officials through a program called Personal Applied Skills Streaming, which began in fiscal year 1997. This program is designed to reduce attrition by mediating problems with recruit discipline, low self-esteem, lack of motivation, poor anger management, and dealing with cultural diversity. Similar programs are in place at Fort Jackson, the Army's largest basic training site, and at Marine Corps and Air Force training installations. Assignment to these remedial programs occurs when a recruit's problems begin to interfere with training. A more preventive or proactive strategy could be developed if attrition risk factors were used to identify and assign recruits most in need of remedial programs. As with selection, however, the use of a survey for assignment would only be effective if false positives were acceptably low.

The primary objective of this study is to examine the predictive accuracy and practical usefulness of items from the SHIP survey for identifying Navy personnel at risk for attrition in basic training.

Methods

The current effort used the subject pool of 66,690 Navy personnel identified by Booth-Kewley et al.[2] The 66,690 individuals included 52,142 basic training graduates (78% of the sample) and 14,548 basic training attrites (22%). Given that Navy basic training attrition has been approximately 14 to 17% in recent years, attrites are somewhat overrepresented here as a result of including all personnel whose performance could be tracked to the 1-year mark (a strategy that disproportionately collects subjects who fail early). The sample consisted of 55,856 men (84%) and 10,834 women (16%). Ethnically, the sample was 59% white, 18% African American, 10% Hispanic, 4% Asian, 4% Native American, 1% Pacific Islander, and 4% self-classified as "other." The mean age of the sample was 19.9 years (mode = 18, SD = 2.7).

Our analyses of basic training attrition are restricted to overall comparisons of personnel who attrite vs. those who complete

basic training. We focus on overall attrition (rather than exploring attrition subcategories) because it is the most direct means to examine the potential operational value of SHIP items as screening tools. A second reason for focusing on overall attrition is that conceptual differences between the primary attrition categories (i.e., behavioral, medical, and administrative) are blurred by the fact that they are associated with many of the same background factors. Our suggestion that attrition categories are not conceptually distinct is consistent with earlier work by Talcott et al.[5] and with a RAND study reporting that separated personnel are often eligible for multiple attrition categories.[6]

Identification of Basic Training Attrition Predictors

A major goal of this effort was to determine the best subset of SHIP items for predicting basic training attrition. Exploratory univariate analyses revealed 43 items for inclusion in a multivariable model. These 43 items were considered for entry into a logistic regression analysis to predict a dichotomous attrition variable, coded as 1 or 0. Items were entered into the model if significant at $p < 0.05$. After all significant variables were entered, a backward elimination procedure was used, and variables were eliminated from the model if their statistical significance was $p > 0.10$. Consequently, 40 SHIP items were included in the final model.

Factor analysis was then performed to determine whether the 40 items might define a smaller number of dimensions. Varimax rotation was used, and factors with an eigenvalue of 1.0 or more were retained. All statistical analyses were performed using SPSS for Windows, release 10.0 (SPSS Inc., Chicago, Illinois).

Results

Table I shows the 40 SHIP items retained in the final logistic regression model to predict basic training attrition. As can be seen, the significant items are diverse and include both behavioral and medical content. The SHIP items are sorted by odds ratio from highest to lowest, giving some indication of their relative significance for predicting attrition. Also shown are endorsement rates (the numbers and percentages of respondents who indicated "yes") for each item among the 52,142 basic training graduates and 14,548 basic training attrites. For example, 3.3% of basic training attrites reported having asthma symptoms in the last 12 months, whereas only 0.2% of basic training graduates had such symptoms.

Indeed, the two questions related to asthma and asthma symptoms were the most significant predictors of basic training attrition, with attrites endorsing these items far more often than graduates. Accordingly, the odds ratios for these items (3.06 and 2.81, respectively) indicate that trainees who report asthma-related symptoms are approximately three times as likely to attrite as other recruits. Because the overall endorsement rates for the asthma-related items were low, however, such symptoms are too rare to account for many specific attrition cases.

Several behavioral items are consequential because they were significantly predictive of attrition and somewhat frequently endorsed by attrites. For example, 38.4% of the attrites reported being tobacco smokers vs. 21.7% of the successful graduates. Similarly, 26.4% of attrites reported that they had been previously suspended or expelled from school vs. only 11.8% of the basic training graduates. Also, 21.9% of the attrites had previously been in a hospital overnight vs. 12.8% of the graduates. Thus, certain background factors identified in these analyses appear to be frequently present in cases of attrition.

Because it is difficult to interpret 40 individual items that predict attrition, factor analysis was used for simplification as described below.

Factor Analysis of Valid Items

Ten factors were extracted from the set of 40 items in Table I, accounting for 40.7% of the variance. The rotated factors are shown in Figure 1, with factor loadings of less than 0.40 omitted for the sake of clarity and ease of interpretation. Because Figure 1 is based entirely on SHIP items that are significantly related to attrition, these 10 factors can be thought of as attrition "risk factors" and are labeled as such.

In most cases, these attrition risk factors are fairly easy to interpret and label (labels are shown at the top of Fig. 1). Risk factor 1, accounting for 11.6% of the variance among the 40 SHIP items, is labeled "depression/anxiety" based on the six items with loadings greater than 0.40. The three highest loading items on risk factor 1 clearly indicate psychological distress, because they refer to depression and worry, disturbed sleep, appetite, and concentration, and suicidal thoughts or attempts. The next three items (fainting and dizziness, chest pain and pressure, and back pain), although nominally physical in nature, all refer to symptoms that frequently have no organic basis and are often associated with psychological distress.[7,8] These six items clustered together to form the largest factor to emerge from our analysis.

Risk factor 2, accounting for 4.9% of the variance, reflects asthma symptoms and breathing problems, including shortness of breath. Risk factor 3, accounting for 4.0% of the variance, reflects tobacco use. It is interesting that tobacco use per se (i.e., yes/no) and frequency of tobacco use both make independent contributions to attrition prediction. This finding may simply indicate that relatively heavy smoking is a risk by itself independent of smoking status.

Risk factor 4 pertains to past misconduct and includes behaviors such as thefts, vandalism, school suspensions, and drug use. Risk factors 5 to 9 pertain to ear/nose/throat problems, bone or joint dysfunction, headaches, hospitalizations and broken bones, and current medications and illnesses, respectively. Risk factor 10, based on two seemingly disparate items addressing flat feet and tooth or gum trouble, is potentially a statistical fluke but was nevertheless retained to accurately reflect the data. Risk factors 4 to 10 each account for less than 4% of the total variance.

In summary, the 40 SHIP questions that predict attrition reflect, to some extent, 10 primary types of behavioral and medical problems, or "risk factors."

Correlations with Attrition

To determine the usefulness of the risk factors for predicting attrition, scores for each risk factor were calculated by summing the responses (1 point for yes and 0 for no) to the items loading on the factors. (The ordinal variable measuring tobacco use was dichotomized for inclusion in the tobacco composite, with rare

TABLE I

40 SHIP ITEMS DISTINGUISHING BASIC TRAINING ATTRITES FROM NONATTRITES

SHIP Item	Graduates (n = 52,142)		Attrites (n = 14,548)		Odds Ratio
	No.	%	No.	%	
Asthma symptoms in the last 12 months	124	0.2	473	3.3	3.06
Asthma	150	0.3	429	3.0	2.81
Serious suicide thoughts or suicide attempts	245	0.5	509	3.5	1.74
Ever suspended or expelled from school	6,169	11.8	3,835	26.4	1.73
Bone, joint, or other deformity	246	0.5	293	2.0	1.70
Do you smoke tobacco?	11,303	21.7	5,591	38.4	1.67
Depression or excessive worry	1,527	2.9	1,728	11.9	1.64
Anemia	784	1.5	429	2.9	1.56
Undergone breathing treatments	145	0.3	278	1.9	1.52
Migraine headaches	435	0.8	494	3.4	1.48
History of recurrent knee pain	451	0.9	717	4.9	1.48
Limitations from past bone or muscle injury	682	1.3	725	5.0	1.42
Recurrent back pain	1,042	2.0	1,098	7.6	1.41
Flat feet	1,327	2.5	672	4.6	1.35
Painful or trick shoulder or elbow	188	0.4	250	1.7	1.35
Frequent indigestion	750	1.4	757	5.2	1.34
Fainting or dizziness in the last 12 months not caused by exercise, heat, or standing quickly	823	1.6	912	6.3	1.34
Have you had or do you have broken bones?	5,781	11.4	2,839	20.3	1.33
Severe tooth or gum trouble	1,241	2.4	723	5.0	1.32
Currently ill or under the care of a physician	404	0.8	319	2.2	1.32
Ever been in the hospital overnight?	6,650	12.8	3,170	21.9	1.29
Ever deliberately cut yourself, burned yourself, or tattooed yourself?	2,476	4.8	1,640	11.3	1.28
Arrested for a crime	1,572	3.0	864	6.0	1.27
Impulsive, act without thinking about it	2,097	4.0	1,600	11.0	1.26
Tobacco use per day on average (four-point scale)					1.26
0	42,659	81.8	9,613	66.1	
1	7,908	15.2	3,706	25.5	
2	1,470	2.8	1,107	7.6	
3+	95	0.2	110	0.8	
Frequent or severe headaches	577	1.1	694	4.8	1.25
Problems with past drug use	290	0.6	322	2.2	1.24
Coughed up blood	348	0.7	528	3.6	1.23
Shortness of breath	751	1.4	987	6.8	1.23
Pain or pressure in the chest	977	1.9	1,114	7.7	1.23
Allergies	6,965	13.4	2,997	20.7	1.21
Extended periods of disturbed sleep, appetite, or concentration	1,367	2.6	1,382	9.5	1.19
Taking medication now (including birth control pills)	2,416	4.7	966	6.7	1.19
Cold sores on your lips or in your mouth	2,619	5.0	1,345	9.3	1.17
Problems getting along with teachers, job supervisors, peers, or coworkers in the past	1,963	3.8	1,429	9.8	1.16
Alcohol use per day on average (four-point scale)					1.16
Never	17,948	34.9	3,852	26.9	
Occasionally	29,316	57.0	8,501	59.5	
Weekly	3,756	7.3	1,655	11.6	
Daily	370	0.7	289	2.0	
Heart disease in biological family	4,442	8.5	1,790	12.3	1.15
Ear/nose/throat trouble	1,667	3.2	1,067	7.3	1.12
Ever stolen from others, set fires, killed animals (except hunting), fought with weapons, run away from home for more than two nights, or vandalized property?	2,649	5.1	1,733	11.9	1.11
Sinus problems/sinusitis	3,055	5.9	1,774	12.2	1.09

Comparisons between attrites and nonattrites are significant at $p < 0.05$ for all variables.

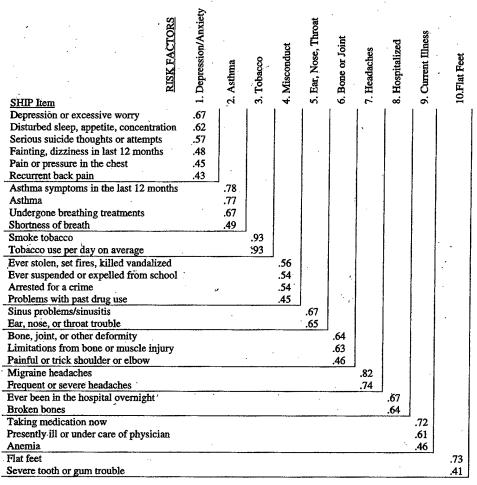| RISK FACTORS	1. Depression/Anxiety	2. Asthma	3. Tobacco	4. Misconduct	5. Ear, Nose, Throat	6. Bone or Joint	7. Headaches	8. Hospitalized	9. Current Illness	10.Flat Feet
SHIP Item										
Depression or excessive worry	.67									
Disturbed sleep, appetite, concentration	.62									
Serious suicide thoughts or attempts	.57									
Fainting, dizziness in last 12 months	.48									
Pain or pressure in the chest	.45									
Recurrent back pain	.43									
Asthma symptoms in the last 12 months		.78								
Asthma		.77								
Undergone breathing treatments		.67								
Shortness of breath		.49								
Smoke tobacco			.93							
Tobacco use per day on average			.93							
Ever stolen, set fires, killed vandalized				.56						
Ever suspended or expelled from school				.54						
Arrested for a crime				.54						
Problems with past drug use				.45						
Sinus problems/sinusitis					.67					
Ear, nose, or throat trouble					.65					
Bone, joint, or other deformity						.64				
Limitations from bone or muscle injury						.63				
Painful or trick shoulder or elbow						.46				
Migraine headaches							.82			
Frequent or severe headaches							.74			
Ever been in the hospital overnight								.67		
Broken bones								.64		
Taking medication now									.72	
Presently ill or under care of physician									.61	
Anemia									.46	
Flat feet										.73
Severe tooth or gum trouble										.41

Fig. 1. Ten risk factors underlying the 40 SHIP items that predict attrition. The following variables did not load on any factor: cold sores; coughed up blood; frequent indigestion; history of recurrent knee pain; heart disease in biological family; alcohol use; deliberately cutting, bruising, or tattooing self; past problems getting along with teachers, supervisors, peers, or coworkers; impulsive acts; and allergies.

smoking scored as 0 and moderate to heavy smoking scored as 1.) In the case of risk factor 1, for example, a factor score composite was calculated by summing responses to the following six items: depression or excessive worry; disturbed sleep, appetite, concentration; serious suicide thoughts or attempts; fainting, dizziness in last 12 months; pain or pressure in chest;

and recurrent back pain. Correlations with attrition were then computed for each factor score (Table II), along with the inter-correlations among the factor scores themselves. As can be seen, the highest correlations with attrition were for depression/anxiety ($r = 0.22$) and misconduct ($r = 0.19$), indicating that the SHIP psychological and behavioral items are somewhat

TABLE II

CORRELATIONS OF SHIP FACTOR COMPOSITES AND BASIC TRAINING ATTRITION

	1	2	3	4	5	6	7	8	9	10	11
1. Depression/anxiety	–										
2. Asthma	0.37	–									
3. Tobacco	0.13	0.07	–								
4. Misconduct	0.27	0.15	0.20	–							
5. Ear/nose/throat	0.27	0.19	0.07	0.14	–						
6. Bone or joint	0.28	0.17	0.07	0.13	0.14	–					
7. Headaches	0.31	0.18	0.06	0.13	0.19	0.15	–				
8. Hospitalized	0.15	0.12	0.11	0.18	0.14	0.15	0.10	–			
9. Current illness	0.13	0.09	0.01	0.05	0.11	0.04	0.09	0.08	–		
10. Flat feet	0.12	0.07	0.06	0.09	0.09	0.06	0.08	0.05	0.03	–	
11. 40-Item composite	0.68	0.45	0.43	0.55	0.45	0.38	0.38	0.45	0.25	0.24	–
12. Attrition	0.22	0.17	0.17	0.19	0.11	0.13	0.12	0.14	0.07	0.08	0.32

All correlations are significant at $p < 0.05$. $N = 62,254$.

better predictors of attrition than are the medical items. The next highest correlations with attrition were for scores related to asthma and tobacco use ($r = 0.17$ in both cases).

The remaining correlations between risk factors and attrition were (in descending order) $r = 0.14$ for having been hospitalized, $r = 0.13$ for bone or joint problems, $r = 0.12$ for headaches, $r = 0.11$ for ear/nose/throat problems, $r = 0.08$ for flat feet, and $r = 0.07$ for current illnesses. Examination of the intercorrelations among the factors themselves also indicates many positive relationships. In particular, the depression/anxiety factor is correlated with asthma, headaches, bone or joint problems, misconduct, and ear/nose/throat problems, among other things. Although some correlates of depression/anxiety are relatively unsurprising (e.g., headaches and misconduct), others are unexpected and somewhat difficult to interpret (e.g., ear/nose/throat problems).

Also shown in Table II are correlations for an overall composite that is the sum of the 40 items listed in Table I. In other words, this composite represents the sum of responses to all 40 SHIP items (one point for each item endorsed) that were significantly related to attrition in the final logistic regression analysis. (Two ordinal variables measuring smoking and alcohol use were dichotomized for inclusion in the composite, with rare smoking and alcohol use each scored as 0 and moderate to heavy smoking and alcohol use each scored as 1.) The correlation between this overall composite and attrition was 0.32, making this the single best predictor of attrition in the table and potentially the score of greatest usefulness for identifying attrition-prone individuals.

Comparison of SHIP with Traditional Attrition Predictors

As noted above, educational credential and AFQT scores have traditionally served as benchmarks for recruit quality and as tools to manage attrition.[1] It is of interest, then, to determine how SHIP compares with these traditional measures as an attrition predictor. For this analysis, educational credential was treated as a dichotomous variable, with individuals having a traditional high school diploma or greater (e.g., with college experience) scored as 1 and individuals without a traditional high school diploma scored as 0. Most of the individuals in the sample (87%) were in the "high school diploma or greater" category. AFQT reflects general mental ability and is reported as a percentile score that can range from 1 to 99.

Correlations among the possible predictors of basic training attrition are shown in Table III. All correlations in the table are significant at $p < 0.05$. As can be seen, the 40-item SHIP composite has a higher correlation with attrition ($r = 0.32$) than does educational credential ($r = -0.11$). The difference between these correlations is significant ($t = 42.38$, $df = 59,634$, $p < 0.001$).

Similarly, the SHIP composite predicts attrition significantly better than does AFQT ($r = -0.10$, $t = 41.93$, $p < 0.001$). Finally, intercorrelations among the predictors indicate that higher scores on the SHIP composite are associated with somewhat lower AFQT scores ($r = -0.08$) and the lack of a traditional high school diploma ($r = -0.10$). To determine the predictive power of all three variables in combination, SHIP scores, AFQT, and educational credential were all entered together in a multiple regression analysis with attrition as the dependent variable. The multiple correlation between these three measures and attrition was 0.34, which is scarcely better than prediction from the SHIP composite alone (i.e., 0.32).

Use of SHIP for Selection from a Cohort

To explore the practical usefulness of the SHIP composite for screening purposes in an actual cohort, we created a subset of data that included 41,882 basic training graduates from the 1997 cohort of Navy recruits, plus 7,207 of their peers who were basic training attrites. Thus, the basic training attrition rate reflects the actual 1997 value of approximately 15%.

We then determined the cumulative frequency of 40-item SHIP composite scores for the attrition and nonattrition groups, as shown in Table IV. As indicated in the table, the recruits' composite scores (representing the total number of items endorsed) ranged from 0 to 29. The values in the two columns at right represent the cumulative number of individuals in each group with the specified SHIP score or greater. Of primary importance is the fact that the values in these columns also represent the number of individuals in each group who would be identified by a particular SHIP cutoff score.

This is best explained by example. If a policy had been implemented in which all individuals with SHIP composite scores of 11 or more were referred to a remedial program at the beginning of basic training, approximately 1% of all recruits would have been referred. At this cutoff score (as shown in Table IV), 358 future basic training attrites would have been correctly referred and 126 basic training graduates would have been incorrectly referred. Similarly, if the SHIP composite had been used in accession screening for this cohort and all individuals with scores of 9 or greater had been rejected from the Navy, 575 attrites would have been correctly rejected, but at the cost of 299 potential basic training graduates who would have been incorrectly rejected. Furthermore, a SHIP composite of 20 or greater identified 32 potential attrites and no potential graduates. By examining Table IV, the potential costs and benefits of attrition reduction policies based on the 40-item SHIP composite can be estimated.

TABLE III

CORRELATIONS FOR PREDICTORS OF BASIC TRAINING ATTRITION

	AFQT	Education	SHIP Composite	All Three Predictors (Multiple Correlations)
AFQT	–			
Education	0.04	–		
SHIP Composite	-0.08	-0.09	–	
Attrition	-0.10	-0.11	0.32	0.34

TABLE IV

DISTRIBUTION OF SHIP 40-ITEM COMPOSITE SCORES ACROSS BASIC TRAINING GRADUATE AND ATTRITION GROUPS FOR THE 1997 COHORT

Score on SHIP Composite	Frequency in Basic Training Graduates (n = 41,882)	Frequency in Basic Training Attrites (n = 7,207)	Cumulative Frequency in Basic Training Graduates[a]	Cumulative Frequency in Basic Training Attrites[a]
0	14,991	1,323	41,882	7,207
1	12,147	1,557	26,891	5,884
2	6,960	1,238	14,744	4,327
3	3,617	849	7,784	3,089
4	1,932	590	4,167	2,240
5	963	428	2,235	1,650
6	524	285	1,272	1,222
7	287	208	748	937
8	162	154	461	729
9	98	120	299	575
10	75	97	201	455
11	37	70	126	358
12	30	62	89	288
13	25	53	59	226
14	10	39	34	173
15	10	28	24	134
16	3	25	14	106
17	6	18	11	81
18	3	23	5	63
19	2	8	2	40
20		7		32
21		8		25
22		4		17
23		4		13
24		2		9
25		2		7
26		3		5
27		1		2
28				
29		1		1

[a] The values in these columns also represent the potential number of individuals in the group who would be affected (e.g., excluded from service) by a particular SHIP cutoff score.

Discussion

The results from the current study indicate that comprehensive health inventories such as the SHIP questionnaire can be potentially useful tools for identifying individuals at risk for basic training attrition. Logistic regression analyses revealed 40 items from the SHIP questionnaire that significantly predicted attrition. Factor analyses indicated that most of the 40 items could be grouped into 10 larger categories, labeled risk factors in the context of the study. Examination of the risk factors and their relationships with attrition indicates that although a number of medical conditions such as bone, joint and ear/nose/throat problems can be linked to early personnel loss, the best predictors are psychological and behavioral in nature. In particular, a history of depression, anxiety, and misconduct was shown to represent the greatest risk for basic training attrition, a finding that is consistent with previous research.[9,10] Because SHIP was not developed as an attrition screening tool, it is likely that an even more sensitive screening tool could be developed based on behavioral and psychological factors.

The present findings could be used in a variety of ways. For example, they could help form the basis for new screening programs to identify individuals at risk for attrition, potentially either to discourage their enlistment or for placement in reme-dial programs after enlistment. For either purpose, it is likely that a composite including all 40 valid SHIP items would be the most efficient tool because the latter provided the highest correlation with attrition. Indeed, perhaps the most impressive finding to emerge is the fact that the 40-item composite is a considerably more powerful attrition predictor than is either educational credential or mental ability score (AFQT), which together are currently the Department of Defense's primary attrition management tools.

We have simulated the consequences for basic training attrition of using different cutoff scores on the composite of the 40 valid SHIP items so that various hypothetical screening strategies can be considered. Although the SHIP tool was not very sensitive at identifying large numbers of future attrites, its high specificity and positive predictive value (at scores greater than 10) make it superior to other attrition management tools.

Because the SHIP questionnaire is routinely administered to all Navy recruits, endorsement of attrition-linked items could be used in a number of ways, including assignment of at-risk recruits to attrition prevention programs during recruit training. Such programs are already in place for populations such as recruits without high school diplomas and could accommodate additional at-risk recruits to some extent. In addition, the Navy

might want to evaluate the desirability of steering personnel with a relatively higher attrition probability into career fields in which training is somewhat inexpensive. That way, the Navy could minimize the training-related portion of its financial losses caused by attrition.

In addition to screening, however, the current results also can be used to identify specific areas in which additional research or interventions may be needed. For example, 38.4% of the attrites reported being tobacco smokers vs. 21.7% of the successful graduates, a finding consistent with other research linking smoking to attrition.[11] Our results, showing increased attrition risk for smokers, indicate the need for additional work to understand the connection between smoking and attrition and to design programs for attrition reduction in smokers. Overall, however, our results primarily indicate that remedial programs should continue to address psychological problems in recruits, including depression and anxiety.

There are several limitations to this work. First, the yes/no response format for most of the SHIP items limits their value as prediction tools by reducing variation between individuals (e.g., a two-point yes/no scale blurs distinctions between individuals compared with a seven-point "how often" scale). Any planned operational use of SHIP items in screening decisions should be preceded by revision of the questionnaire to include an expanded response scale and a subsequent reexamination of validity. Second, the validity of SHIP items for predicting attrition may vary as a function of when the questionnaire is given. In particular, the honesty of responses may be different for military applicants vs. basic training recruits such as the current sample. Further study of item endorsement rates as a function of applicant/enlistee status is needed, along with comparisons of item validity in these two populations.

Finally, because attrition is such a complex issue, any change in policy should be preceded by a careful analysis of potential impact. For example, the full economic benefits of attrition screening on survey instruments such as the SHIP questionnaire can only be assessed over a cohort's full term of enlistment, because many basic training graduates subsequently at-

trite from follow-on training programs and from the fleet. Indeed, almost 9,000 of our basic training graduates were subsequently discharged before completing 1 year of service. Our results for basic training attrition, however, provide a promising beginning, because they indicate that AFQT scores and educational credential, although invaluable as broad personnel quality indices, can clearly be improved on as attrition management tools.

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